# PERFORMING ARTS AND ADVANCED NETWORKING

JUSTIN TRIEGER, DIRECTOR OF NEW MEDIA AND DISTANCE LEARNING NEW WORLD SYMPHONY





#### About New World Symphony (NWS)

- 87 Fellowship Musicians, most post-graduate, for up to 3 years
- 100+ Concert Productions each year
- Educational programs geared towards leadership, musical excellence, professional training, community outreach and entrepreneurship

#### **Requirements for Online Learning**







Ease of Use – complexity of hardware setup and software operation

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Quality – the perceived quality of the solution at full capability

Latency – the time it takes from the signal to get from A to B



Accessibility - how widely the platform is used

## Early Experiments (2002-2006)



#### DVTS (Digital Video Transport System)

-IP Version	Options	About.
C IPv6	DV Device:	EXI
Port Number	DIF Block Size: 17  Frame Discard Level: 1	2
Multicast		
TTL: 1 Interface: Intern	et2 Nic Connection (67.17.206.147)	
V Receive		
	✓ Monitor Output	
⊂ IPv6	TEEE 1394 Output	
Port Number	Multicast Group:	
8000 Change	Source: Join	
	Interface: Internet2 Nic Connection (67.17.206.147)	

• DV Specification

- Firewire and HDV Cameras
- Windows Only

#### DVTS – The "Good"

DVTS for WindowsXP Ver.0.0.2		
DV Send         Of           IP Version         Of           IP V4         Di           IP V6         Di           Port Number         Di           8000         Fr	otions estination Host V Device: IF Block Size: 17 rame Discard Level: 1	About Exit
Multicast TTL: 1 Interface: Internet2 Nic Co	nnection (67.17.206.147)	
DV Receive	Itput Monitor Output IEEE 1394 Output	
Port Number Gi 8000 Change Sc In	ulticast roup: Join terface: Internet2 Nic Connection (67.17.206.147)	
Packet Count: 0 Packet Lost: 0	VideoType: Unknown Start Receive	
Ready.	IPv4 8000 Monitor	Unknow

- Stereo, uncompressed 44.1Khz PCM audio
- Multicast enabled
- Free

#### DVTS – The Bad

DVTS for WindowsXP Ver.0.0.2		
DV Send IP Version C IPv4 C IPv6 Port Number [8000	Options Destination Host: DV Device: DIF Block Size: Frame Discard Level:	About Exit
DV Receive IP Version P Version	Connection (67.17.206.147)  Start Send Output Monitor Output	
C IPv6 Port Number [8000 Change	TEEE 1394 Output	
Packet Count: 0 Packet Lost: ( Ready.	VideoType:     Unknown     Start Receive       IPv4     8000     Monitor	Unknow

- 200ms+ latency
- Standard Definition
- No error-correction (UDP)
- No echo-cancellation

### ConferenceXP

- Originally developed by Microsoft
- Windows Only
- Utilizes Windows Media Encoder codecs



#### ConferenceXP – The Good

- Works with most consumer and professional devices
- Variable bandwidth allocation for audio and video
- Easy multipoint
- Security transversal possible



#### ConferenceXP – The Bad

- Uses antiquated compression scheme out-of-the-box
- Heavy CPU utilization
- P2P connections are buggy
- Last commit was in 2015



#### H.323



- Low-bandwidth
- Ubiquitous in higher education
- Commercial solution
- Secure

#### H.323 – The Good



- HD Resolutions
- Low bandwidth
- Error correction
- Easy Multipoint
- Onboard Echo Cancellation

#### H.323 – The Bad



- Best sounding codecs are proprietary
- Expensive
- Onboard Echo Cancellation
- Awkward handshaking between manufacturers

## Ultragrid

- Software solution
- Developed by Czech Republic R&E network in 2002
- Used in a variety of scientific environments (and the Arts)



#### Ultragrid – The Good

- Uses commodity hardware
- Support for up to 8K resolution
- Excellent technical support
- Works on a variety of OS
- Latency as low as 40ms



#### Ultragrid – The Bad

- Command line operation is most stable
- Tricky installation depending on Operating System
- Requires a good deal of bandwidth in some cases



#### LOLA



- Originally released in 2011 by GARR
- Windows only
- Color or B&W video
- Growing international user group

#### LOLA – The Good



- Variable video resolution (480 – 1200p)
- Multi-channel audio support
- Super simple GUI
- Works with (particular) professional audio gear

#### LOLA – The Bad



- Requires 20 800Mbps
- Does not play well with firewalls
- No Multi-point (yet...)
- Requires specialized USB3 cameras

### MVTP/Nimbra





- UDP based delivery systems
- Designed for professional broadcast
- Standalone devices
- Based on FPGA circuits

#### MVTP/Nimbra – The Good





- Multi-channel support for audio AND video
- Error correction and recovery



- Commercially supported
- Ultra low latency

#### MVTP/Nimbra – The Bad





- High bandwidth utilization without compression
- Requires very high-quality and consistent network connections, ideally with synchronization
- Very expensive











Ease of Use
A/V Quality
Latency
Accessibility

#### Current Challenges

- Solutions are either too expensive, too complicated or require substantial bandwidth free of security measures
- All solutions require some understanding of audio, video, networking and lighting in order to use for highest impact
- The networks are slowing us down (and causing us anxiety)
- Display technology is imperfect (i.e. SLOOOOOW)
- Physical connections still required



## Near in the Distance

# **Global Audition Training Project**







# What's Next?







#### Binaural Audio

#### Ambisonics







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